EFFECT OF DIFFERENT LEVEL *Lactobacillus plantarum* ON PHYSICO-CHEMICAL PROPERTIES OF FERMENTED GOAT *DENDENG*

UNDERGRADUATE THESIS

By :
Abdurahman Ath Thoifi
NIM. 145050101111054

ANIMAL SCIENCE STUDY PROGRAM
FACULTY OF ANIMAL SCIENCE
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Undergraduate thesis as one of the requirements for
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Student:
Abdurahman Ath Thoifi
SIN. 145050101111054

Have passed the Bachelor Examination
At April 19th, 2018

	Signature	Date
Supervisor:		
Prof. Dr. Ir. Lilik Eka R., MS		
EIN. 19590823 198609 2 001	.....	11-07-2018
Co Supervisor:		
Dr. Agus Susilo, S.Pt., MP		
EIN. 19730820 199802 1 002	.....	06-07-2018
Examiner 1:		
Firman Jaya, S.Pt., MP		
EIN. 19820308 201012 1 001	.....	06-07-2018
Examiner 2:		
Dr. Ir. Bambang Ali N., MS.DAA		
EIN. 19610414 198603 1 004	.....	24-05-2018
Examiner 3:		
Dr. Ir. Ita Wahyu Nursita, M.Sc		
EIN. 19630508 198802 2 001	.....	23-05-2018

Approved by:
Dean of Faculty of Animal Science,
University of Brawijaya

Prof. Dr. Sc. Agr. Ir. Suyadi, MS
EIN. 19620403 198701 1 001
Date 11-07-2018

STATEMENT LETTER
RESEARCH GROUP

Research group members:

1. Name : Abdurahman Ath Thoifi
   SIN : 145050101111054
   Tittle : Effect of Different Level *Lactobacillus plantarum* on Physico-Chemical Fermented Goat Meat *Dendeng*
   Variable : Moisture content, Aw, Protein Content, Dissolved Protein Content, and Protein Profile
2. Name : Riris Nur Hapsari
   SIN : 145050100111237
   Title : Effect of Different Level *Lactobacillus plantarum* As A Starter Culture on Fermented Goat Meat *Dendeng*
   Variable : pH, Texture, Color L*, a*, B*, Total Titrable Acidity, Total Lactic Acid Bacteria
3. Name : Desi Putri Natalena
   SIN : 1450501071110004
   Title : Effect of Different Level *Lactobacillus plantarum* on Organoleptic, Total Plate Count (TPC), Fat and Cholesterol Content Fermented Goat Meat *Dendeng*
   Variable : Organoleptic, Total Plate Count (TPC), Fat and Cholesterol Content

At this moment states in full that we are one group of the research about the addition of *Lactobacillus plantarum* on goat meat *dendeng* fermented.

Supervisor

(Prof. Dr. Ir. Lilik Eka Radiati, MS.)
NIP. 195908231986092001
Date 11-07-2018

Co-Supervisor

(Dr. Agus Susilo, S.Pt.,MP)
NIP. 197308201998021002
Date 06-07-2018

BIOGRAPHY

Abdurahman Ath Thoifi. The author was born on August 22nd, 1996 in Bandar Lampung. The author is the first son from Mi'roji and Rika Damayanti. Author's formal education started a study on four years old in Fitrah Insani Islamic Kindergarten and continued to Permata Bunda Islamic Elementary School. The author was graduated in 2008 and continued his study in Fitrah Insani Islamic Junior High School Bandar Lampung. In 2011, the author continued his study at 14th Public Senior High School Bandar Lampung (SMAN 14 Bandar Lampung) and finished his study in 2014; the author continued again for his bachelor degree in Animal Science Faculty in Brawijaya University.

During college students, the author becomes one of the members of English Class 2014. He has been joining some organizations such as Executive Council of Students in Animal Science Faculty as Communication and Information Staff in 2015 and 2016. Active in Executive Council of Students in Brawijaya University as Youth and Sports Affairs Staff in 2016. In 2017, the author became Vice Head of Information and Communication Center Bureau, Executive Council of Students in Brawijaya University. The author also joined some committees such as Arek Malang Mulang Tiyuh 2015 as public relation, Olimpiade Tempo Doeloe 2016 as Coordinator of PDD (Publication, Documentation, Decoration), Olimpiade Brawijaya as DDM (Documentation, Decoration, Multimedia) staff, and Jawara Cup EM UB 2016 as a public relation.

The author performed the internship at Balai Besar Kulit, Karet, dan Plastik Yogyakarta in a month. Now writing an undergraduate thesis about EFFECT OF DIFFERENT LEVEL *Lactobacillus plantarum* ON PHYSICO-CHEMICAL PROPERTIES OF FERMENTED GOAT *DENDENG* in the term to get the bachelor degree with the guidance of Prof. Dr. Ir. Lilik Eka Radiati, MS and Dr. Agus Susilo, S. Pt, MP

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Malang, May 2018

Author

PENGARUH TINGKAT *Lactobacillus plantarum* YANG BERBEDA TERHADAP KANDUNGAN FISIKO-KIMIA PADA *DENDENG* DAGING KAMBING FERMENTASI

Abdurahman Ath Thoifi[1)], Lilik Eka Radiati[2)], and Agus Susilo[2)]

1) Mahasiswa Jurusan Teknologi Hasil Ternak, Fakultas Peternakan, Universitas Brawijaya
2) Dosen Jurusan Teknologi Hasil Ternak, Fakultas Peternakan, Universitas Brawijaya

E-mail: ath22thoifi@gmail.com

ABSTRAK

Tujuan penelitian ini adalah untuk mengetahui pengaruh pemberian *Lactobacillus plantarum* terhadap *dendeng* kambing yang difermentasi terhadap kadar air, Aw, kadar protein, kandungan protein terlarut dan profil protein. Metode penelitian yaitu eksperimen dengan empat ulangan dan empat perlakuan terdiri dari 0 ml *Lactobacillus plantarum* (T_0), 0.3 ml *Lactobacillus plantarum* (T_1), 3 ml *Lactobacillus plantarum* (T_2), and 30 ml *Lactobacillus plantarum* (T_3), dengan analisis statistik menggunakan Rancangan Acak Lengkap jika ada pengaruh yang signifikan akan diikuti oleh Uji Jarak Berganda Duncan. Variabel penelitian ini adalah kadar air, Aw, kadar protein, kadar protein terlarut dan profil protein. Hasil penelitian menunjukkan bahwa *Lactobacillus plantarum* pada *dendeng* kambing fermentasi memiliki pengaruh yang sangat nyata ($P < 0,01$) dengan nilai kadar air 44,24 - 46,65%, Aw 0,61 - 0,70, kadar protein 31,98 - 38,70%, dan kadar protein terlarut 3,55 - 4,21%. Profil protein menunjukkan bahwa berat molekul 16.69-143.54 kDa dengan T_0 memiliki pita protein yang tidak dapat terbaca, T_1 memiliki enam pita protein, T_2 memiliki tujuh pita protein, dan T_3 memiliki delapan pita protein.

Kata kunci: *Fermentasi, protein, bakteri asam laktat, kadar air, aktivitas air*

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Abdurahman Ath Thoifi[1)], Lilik Eka Radiati[2)], and Agus Susilo[2)]

[1)]Student of Animal Product Technology Department, Faculty of Animal Science, Brawijaya University
[2)]Lecturer of Animal Product Technology Department, Faculty of Animal Science, Brawijaya University

E-mail: ath22thoifi@gmail.com

ABSTRACT

The goals of this research was to determine the effect of *Lactobacillus plantarum* on fermented goat *dendeng* regarding moisture content, aw, protein content, dissolved protein content and protein profile. The research method was using experimental design with four replications and four treatments consist of 0 ml *Lactobacillus plantarum* (T_0), 0.3 ml *Lactobacillus plantarum* (T_1), 3 ml *Lactobacillus plantarum* (T_2), and 30 ml *Lactobacillus plantarum* (T_3), with the statistical analysis was using Completely Randomized Design if there were significant effect would be followed by Duncan's Multiple Range Test. Variable of this research were moisture content, Aw, protein content, dissolved protein content and protein profile. The result showed that *Lactobacillus plantarum* on fermented goat *dendeng* had a highly significant effect ($P<0.01$) about Aw value 0.61 – 0.70, moisture content 44.24 – 46.65%, protein content 31.98 – 38.70% and dissolved protein content 3.55 – 4.21%. Protein profile showed that the molecular weight 16.69-143.54 kDa with T_0 had unreadable protein band, T_1 had six protein bands, T_2 had seven protein bands, and T_3 had eight protein bands.

Keywords: *Fermentation, protein, lactic acid bacteria, moisture, water activity*

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Abdurahman Ath Thoifi[1)], Lilik Eka Radiati[2)], and Agus Susilo[2)]

[1)]Student of Animal Product Technology Department, Faculty of Animal Science, Brawijaya University
[2)]Lecturer of Animal Product Technology Department, Faculty of Animal Science, Brawijaya University

E-mail: ath22thoifi@gmail.com

SUMMARY

The meat was one of the food sources of animal protein needed by humans. Meat processed to various products, *dendeng* was one of them. *Dendeng* was Indonesian dried meat product used spices, rich in the antioxidant component as an ingredient. *Lactobacillus plantarum* could increase the moisture content, Aw, protein content, dissolved protein content, and changed the molecular weight of the protein of fermented goat *dendeng*. The purpose of this research was to determine the effect of *Lactobacillus plantarum* on fermented goat *dendeng*. The result of the research used as information of *Lactobacillus plantarum* to make fermented goat *dendeng*.

The material used for this research was *dendeng* that made from goat meat. The additional material was spices and *Lactobacillus plantarum.* The experimental design research method was using Completely Randomized Design with four treatments and four replications, consist of 0 ml *Lactobacillus plantarum* (T_0), 0.3 ml *Lactobacillus plantarum* (T_1), 3 ml *Lactobacillus plantarum* (T_2), and 30 ml *Lactobacillus plantarum* (T_3). Variable of this research were moisture content, Aw, protein content, dissolved protein content and protein profile. Data analysis used ANOVA (Analysis of Variance) and

followed with Duncan's Multiple Range Test if there was a significant value.

The result showed that *Lactobacillus plantarum* on fermented goat *dendeng* had a highly significant effect ($P<0.01$) about Aw value 0.61 – 0.70, moisture content 44.24 – 46.65%, protein content 31.98 – 38.70% and dissolved protein content 3.55 – 4.21%. Protein profile showed that the molecular weight 20.87-117.36 kDa with T_0 had unreadable protein band, T_1 had six protein bands, T_2 had seven protein bands, and T_3 had eight protein bands. Moisture content decreased due to the heating process but, *dendeng* with the addition of *Lactobacillus plantarum* (T_1, T_2, T_3) have higher moisture content than T_0. Aw value increased from T_0 to T_3 because of its high moisture content on T_3. Protein content increased due to the hydrolysis process during fermentation. Dissolved protein content increase because of its high protein content and related with high moisture content, some protein soluble in water. Electrophoresis bands formed at most on T_3 treatment while in T_0 treatment of the band was unreadable. Goat meat processed become fermented goat *dendeng* had nutritional value (moisture content, aw, protein) which was still feasible for human consumption. Further research would need a test to determine the name of protein types and amino acid contained in fermented goat *dendeng*.

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LIST OF ABBREVIATION

et al.,	: *et alii*
mg	: milligram
g	: gram
±	: plus minus
℃	: degree celcius
pH	: potential hydrogen
ml	: mililitre
rpm	: rotation per minute
nm	: nanometer
kDa	: kilodalton
%	: percentage
Aw	: water activity
CFU	: colony forming unit

CHAPTER I
INTRODUCTION

1.1 Background

Meat is one of the food sources of animal protein need by humans, which is a source of energy along with other energy sources such as carbohydrates and fats and helps the growth and maintenance of body tissues. The level of meat consumption in Indonesian society is very low. However, the national need for meat is very high. Indonesia's demand for/keeps growing and causes the increasing gap between its low national beef production and high consumption scale. This matter leads Indonesia to import bovine from other countries (Princy, 2016). Beef self-sufficiency that proclaims by the government is still far from expectations, substitution from beef to goat meat can be a good choice. However, the level of consumption in goat meat is very low because of goat meat has a specific aroma that most people unlike and have tough/clay texture. Goat meat must process properly to reduce the smell and tough/clay texture that most people unlike in hope to increase the consumption interest. According to Ozawa, Nishitani, Odake, Lopez, and Blair (2005), the main impression of goat meat by the respondents is "uncommonly eat at home" (61%), whereas "smelly" and "never thought about goat meat" are also important. "Small numbers of goats and breeders" and "less custom to eat goat meat" suggest as the two major reasons why goat meat rarely sell at meat shops. Only 16% of respondents eat goat meat before. Improving the smell of goat meat and combining the sale of goat meat with recipes may increase goat meat demand among housewives.

Meat process becomes *dendeng* is very common in Indonesia. Processing meat becomes *dendeng* consider to increase the flavor of the meat and can extend the shelf life. Spices neutralize any unpleasant odors present in food (Li et al., 2016). Milling process will tender the meat. Intermediate Moisture Food has point out that reduce spoilage, improve safety, increase shelf life (Erickson, 1982). *Dendeng* is traditional processed meat that knows for a long time in the public. Nummer, Judy, Mark, Patricia, John, and Elizabeth (2004) stated that drying meat for food preservation begin with the earliest civilizations. Meats strip or pull, then dry with the help of the sun, wind, or fire. Jerky is more of a convenient snack food where safe preservation, flavor, and texture are important. Jerky could make from almost any lean meat, including beef, pork, poultry. The simplest method to make jerky is to cut meat into strips and dry it. More typically, spices or marinades are used to flavor the meat and preservation or smoking may use in combination with drying to make jerky.

The fermentation process can change complex compounds to be simpler so that fermented food can absorb well by the human body. The fermentation process is considering improving the quality of food. Fermentation is a relatively inexpensive process that forms for a long time. According to Yilmaz and Murat (2009), Fermentation is an ancient process that use to prevent foods and this process widely practice in the meat industry as a method of preparing and preserving meat. The bacteria, *Lactobacillus*, *Staphylococcus* and *Micrococcus*, play the most important role in this microbial process. Additionally, certain types of yeasts and molds also use in the production of some special fermented meat products. The meat products produce with this method are mostly approve in

the meaning of consumers' acceptance. The fermentation process using *Lactobacillus plantarum* assist. *Lactobacillus plantarum* produce different antimicrobial compounds such as organic acids, hydrogen peroxide, diacetyl, and also bacteriocins and antimicrobial peptides (Arena et al., 2016).

The process of fermentation by the appropriate way and the level can produce protein products, decrease fat content, and form (simplify) complex carbohydrates (Suhendra, Samsudin, dan Melati, 2010). Fermentation process in meat proves that have a protein higher than the standard according to Atma (2015) state that the nutritional content of beef sausage fermented with 1.5% Angkak has a protein content of 16.56% from minimum standards of the Indonesian National Standard 1995 with a minimum value of 13%. Afrila and Santoso (2011) state that the value of protein content of *dendeng* in the treatment of ginger extract concentration and different damping periods range from 15.6% -17.4%. The value of Aw (water activity) on *dendeng* with the addition of ginger extract and duration difference of immersion period according to Afrila and Jaya (2012) state that the value of Aw *dendeng* range from 0.44 to 0.49. Indonesian national standard recommends the value of water activity (Aw) in around 0.4-0.9. If, the sample (*dendeng*) have a water activity (Aw) is not too high or not too low, i.e., between the range 0.50-0.90 then the sample (*dendeng*) can be durable during storage. Mean moisture content values (%) for dry fermented lamb-meat sausage during processing and storage is range from 32.84% to 57.32% (Bowser, Mwavita, Sakini, McGlynn, and Maness, 2014). Food quality and shelf life need to increase, the appeal of people to consume goat meat will increase too. To know the existence of quality improvement in goat meat that process become fermented goat

dendeng then test includes moisture content, aw, protein content, dissolved protein content and protein profile.

1.2 Problems

The problem of the study stated in the following question: How is the best level of lactic acid bacteria *Lactobacillus plantarum* used on making fermented goat *dendeng* for moisture content, Aw, protein content, dissolved protein content, and protein profile test?

1.3 Goals

The goal of this research is to know the effect of different level of lactic acid bacteria *Lactobacillus plantarum* of moisture content, Aw, protein content, dissolved protein content, and protein profile for fermented goat *dendeng*.

1.4 Advantages

The advantage of this research for further studies is to provide information about the processing of fermented goat *dendeng* which is best in quality and can implement in the community and as a reference. The advantage of this research for the product is to add flavor, increase shelf life, and improve the quality of goat meat.

1.5 Hypothesis

Different level of lactic acid bacteria *Lactobacillus plantarum* may increase moisture content, Aw, protein content, dissolved protein content and change molecular weight in protein profile on fermented goat *dendeng*.

1.6 Framework

Goat meat is a food source of animal protein for the human body. Although it is a good source of protein for the body, goat meat has unaccepted in the community due to the unpleasant smell and the character of its meat is hard and tough/clay. It will process become *dendeng* whose will expect reduce the smell of goat meat. Goat meat process become *dendeng* with milling process and use addition of spices (palm sugar, garlic, coriander, galangal, cumin, salt, and pepper). Spices neutralize any unpleasant odors present in food (Li et al., 2016). Milling process will tender the meat. Also, process goat meat become fermented *dendeng* (Intermediate Moisture Food) will reduce the moisture content of the meat so, the meat would be more durable because meat is food that easily damages by microbial pathogen disorders, the reduction in moisture content can inhibit the growth of pathogenic microbes. IMF has point out that reduce spoilage, improve safety, increase shelf life (Erickson, 1982).

Dendeng process with fermentation using *Lactobacillus plantarum* with the treatment T_0: without addition of that *Lactobacillus plantarum*, T_1: 0.3 ml *Lactobacillus plantarum*, T_2: 3 ml *Lactobacillus plantarum*, and T_3: 30 ml *Lactobacillus plantarum* that hope can improve the quality of meat. *Lactobacillus plantarum* produce different antimicrobial compounds such as organic acids, hydrogen peroxide, diacetyl, and also bacteriocins and antimicrobial peptides (Arena et al., 2016). Addition of *Lactobacillus plantarum* starter for making the goat meat *dendeng* expects to assist in the fermentation process to perform a hydrolysis activity on goat meat.

Efficiency of *Lactobacillus plantarum* starter used of fermented goat *dendeng* will review for moisture content, Aw, protein content, dissolved protein content, and protein profile. The fermentation form the amount of water released (Chen et al., 2016). High moisture content then, will obtain high Aw value (Legowo and Nurmanto, 2004). The process of fermentation by appropriate way and level is able to produce protein products (Suhendra et al., 2010). Dissolved protein increase due to the fermentation process (Onweluzo and Nwabugwu, 2009). The protein composition change along the fermentation (Wang et al., 2017). The addition of *Lactobacillus plantarum* may increase moisture content, Aw, protein content, dissolved protein content, and change molecular weight in protein profile on fermented goat *dendeng*. The research framework scheme shows in Figure 1.

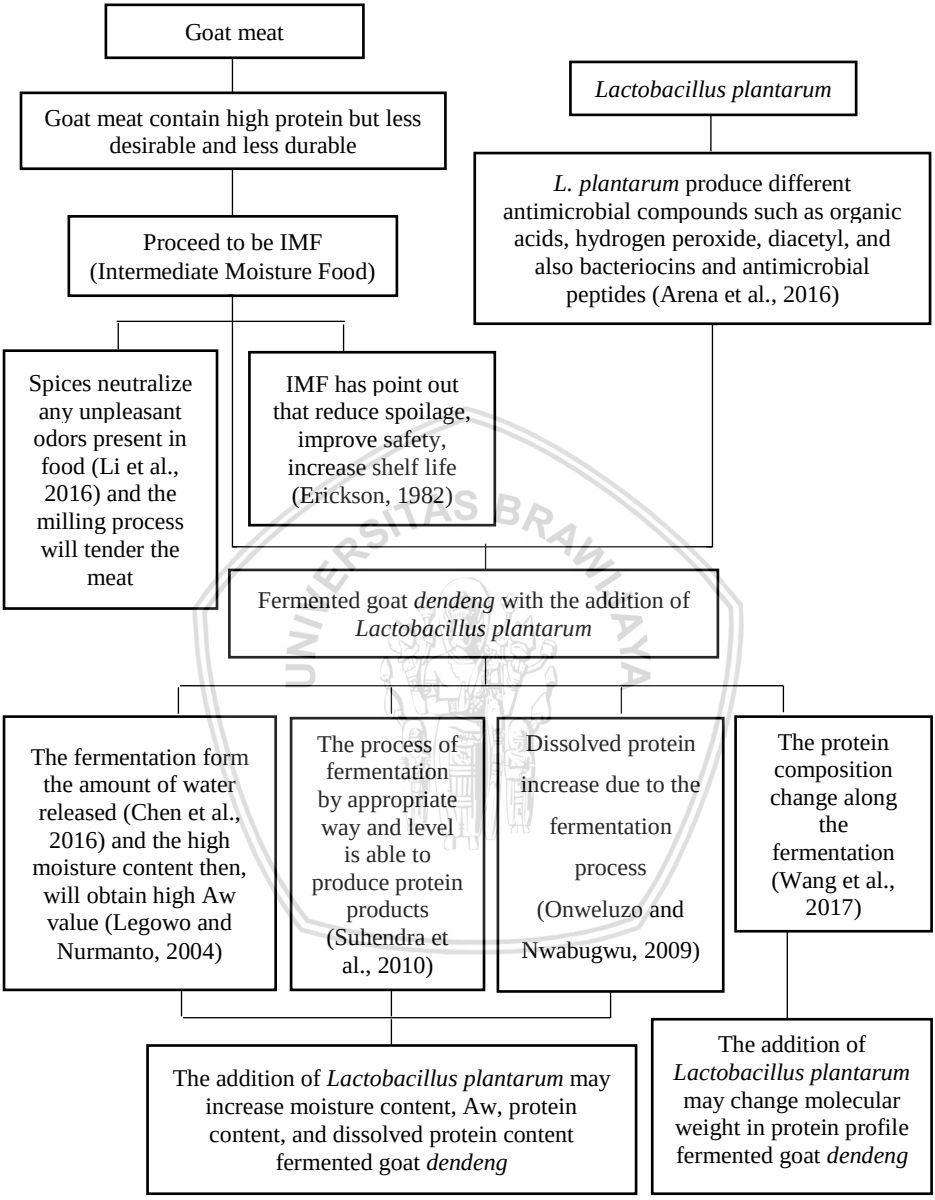

Figure 1. Framework Scheme of Research

CHAPTER II
LITERATURE REVIEW

2.1 Goat Meat

The meat was a complex and nutritious component that was significant from food. Many factors included species, animal sex, growth rate and animal maturation, diet, genetic factors, disease status, hormonal treatment and use, maintenance conditions, temperature, and relative humidity. The practice of science had a direct and indirect impact on the quality of meat. (Troy and Kerry, 2010). The characteristics of goat meat production received few scientific attention, compared to the livestock species used for meat production; beef, pigs, and sheep. This condition might be due to a preference for other red meats such as beef and pork. In developing countries, goats considered special or exotic livestock, whereas in developing countries - especially in Southeast Asia and Africa - goats were a major source of meat production. (Dhanda, Taylor, Murray, Pegg, and Shand, 2003).

Foods that taste good were unhealthy. Food that tastes good (savory) was because in the food contains a lot of fat, such as food derived from goat meat, beef, chickens, and others. Eating animal fats or vegetable fats could cause excessive obesity, heart disease, hypertension, and others. (Hargono, Abdullah, dan Sumantri, 2008). Goats or sheep meat have a characteristic: unnecessarily all consumers will consume them. The condition was due to this livestock meat had a specific aroma that just some people could accept it. Unlike the beef, buffalo or poultry meat almost everyone wants to consume it. (Winarso dan Yusmichad, 2014).

Goats spread all over the world. They lived in small or large herds and existed in different region and environment. Due to the distinctive taste and desired chemical composition, goat meat interest increased. As animal foods, goat meat rich in protein, vitamins, and minerals, but it contained very little fat, especially cholesterol (Ivanovic, Pavlovic, and Pisinov, 2016). According to Malekian, Khachaturyan, Gebrelul, and Henson (2014), considering their high nutritional value and a greater ratio of unsaturated fatty acids, goat meat had the potential to improve the health of people who rarely consumed meat products from their daily diet. Goat meat consumption was becoming popular and often available.

There were rumors that the consumption of goat meat increased blood pressure, there was no scientific evidence to support this. Experiments performed to unite with goat meat. Moreover, the result showed that, as in chicken meat consumption, goat meat consumption unincrease blood pressure, much amount of salt used in goat meat affected the increase of blood pressure (Sunagawa, Kishi, Nagai, Matsumura, Nagamine, and Uechi, 2013). The market segment for goat meat identified in the Muslim community with its traditions and preferences for goat meat. Meat should produced according to Muslim traditions (Halal) as well as veterinary regulations when targeting this market segment (Asheim, Eik, and Dellal, 2014).

2.2 *Dendeng*

Dendeng is Indonesian dried meat product that used spices rich in the antioxidant component as an ingredient. Also, commercial *dendeng* usually used saltpeter (nitrate/nitrite salt) as preservation ingredient to inhibit rancidity and to produce

stable red color. (Suryati, Astawan, Lioe, and Wresdiyati, 2012). Huang and Nip (2001) stated that *dendeng* had a sweet taste because its sugar content and strong taste of spices and dried meat provided a distinctive flavor that sets it apart from other traditional moisturizing products.

Beef *dendeng* (jerky from Indonesia) was preserved beef with chemical and physical preservation. Beef *dendeng* made with the addition of salt (NaCl) saltpeter (sodium nitrate/nitrite), sugars and "Indonesian Spices" as a spice to thin slices meat or milled meat then dried in the sun or using a drying oven. Beef *dendeng* categorized as a conventional preservation meat product due to the addition of saltpeter (sodium nitrate/nitrite) in the composition of the raw material. (Saputro, Bintoro, and Pramono, 2016). Garlic have long been used in Asian countries to enhance the flavor and to neutralize any unpleasant odors present (Li, Tu, Zhang, Sha, Wang, Pang, Tang, 2016).

Meat products that had a long shelf life were *dendeng* and *abon*. *Dendeng* was one of the durable meat products that classified as preservation meat. Preservation was a process by using of nitrate salt (saltpeter) to maintain the color of meat, distinctive taste and controlled the growth of microorganisms. There were two kinds of *dendeng*: *dendeng* from a thin slice of meat and the second from milled meat and formed. *Dendeng* and Abon became a household industry with varying prices depending on how far the non-meat materials contained in the meat products (Suradi, 2014). An Intermediate Moisture Food was shelf-stable without refrigeration or thermal processing. Intermediate moisture foods had pointed out that reduced spoilage, improved safety, increased shelf-life and retention of soft moist texture are important considerations. Reduction of water activity is frequently necessary to develop an

intermediate moisture food, which is shelf-stable without refrigeration (Erickson, 1982).

Table 1. Terms Quality of Beef *Dendeng* (%) (SNI, 2013)

Test Criteria	Requirement
Moisture Content	Maximum 12%
Fat Content	Maximum 3%
Protein Content	Minimum 18%

2.3 Fermentation

Fermentation was effective in decreased the level of anti-nutritional factors in food and improved starch and protein digestibility, amino acid balance and nutritional value. (Singh, Yadav, and Sharma, 2012). The process of fermentation by appropriate way and the level was able to produce protein products, decreased fat content, and formed (simplified) complex carbohydrates (Suhendra et al., 2010). Fermented foods and beverages continue to make a significant contribution to the overall patterns of traditional dietary practices (Selhub, Logan, and Bested, 2014).

Existing scientific data showed that fermented foods had nutritional and non-nutritive components in food, which had the potential for specific target functionalities in the body relevant to the health and well-being of consumers. Fermented foods had unique functional properties that provided some health benefits to consumers due to the presence of functional microorganisms, which had probiotic, antimicrobial, antioxidant, peptide. The health benefits of some fermented foods were the synthesis of nutrition, prevention of cardiovascular disease, cancer prevention, gastrointestinal disorders, allergic reactions, diabetes, and others (Tamang, Shin, Jung, and Chae, 2016).

L. plantarum strains hold multipurpose features as they can both carry out appreciable fermentative and metabolic processes, e.g., increasing the amount of specific beneficial compounds such as vitamins in the fermented food product, and promote the maintenance of consumers' health, since their capacity to modulate the host immune response and to *de novo* produce vitamins in the human gut (Arena, Fiocco, Massa, Capozzi, and Russo, 2014). Several *L. plantarum* strains have been shown to produce different antimicrobial compounds such as organic acids, hydrogen peroxide, diacetyl, and also bacteriocins and antimicrobial peptides, both denoted by a variable spectrum of action. *L. plantarum* strains were investigated for their possible antimicrobial activity against seven pathogenic bacteria, i.e., *L. monocytogenes*, *S. Enteritidis*, *E. coli* O157:H7, and four strains of *S. aureus*. (Arena, Silvain, Normanno, Grieco, Drider, Spano, and Fiocco, 2016).

2.4 Moisture content

Water was vital for many biological processes and essential for all living organisms (Lebre, Pieter, and Don, 2017). The final moisture content had a significant impact on texture and shelf life, with a lower moisture content lead to confections that typically had a longer shelf life. (Ergun, Lietha, and Hartel, 2010). The moisture content of a foodstuff showed the number of free water molecules present in the food, whereas the water activity (Aw) showed the degree of water availability to be used by microorganism activity. The reduced moisture content in food materials caused a decrease in the value of water activity, so that was food would last longer because the water available for microbial growth was reducing. (Sanger, 2010).

Mean moisture content values (%) for dry fermented lamb-meat sausage during processing and storage was ranged from 32.84% to 57.32% (Bowser et al., 2014). Intermediate moisture foods (IMF) contained between 20 and 50% (w/w) of water (Vermeulen, 2014). The fermentation sausage was most likely the formation of texture dominated by acid-induced muscle protein gelation and the amount of water released (Chen et al., 2016).

2.5 Aw (Water Activity)

Water activity (aw) was a major factor in preventing or limiting growth (bacteria causing foodborne diseases would not grow under aw of 0.85). Further, it could also lead to increased resistance of microorganisms and spores (Sevenich, Reineke, Hecht, Frohling, Rauh, Schluter, and Knur, 2015). Afrila and Jaya (2012) stated that the value of Aw *dendeng* ranged from 0.44 to 0.49. Indonesian national standard recommends the value of water activity (Aw) in around 0.4-0.9. If, the sample (*dendeng*) had a water activity (Aw) was not too high or not too low, i.e., between the ranged 0.50-0.90 then the sample (*dendeng*) could be durable during storage.

Water activity (aw) was the amount of water that microorganisms could use for their growth (Setyanigsih et al., 2014). Legowo and Nurmanto (2004) stated that the relation of moisture content with water activity (aw) indicated by the tendency that the high the moisture content then, would obtain high aw value. Moisture content expressed in percent (%) in the range of 0-100 scale, while the value of aw expressed in decimal places in the range of 0-1.0 scale. Intermediate Moisture Foods (IMF), high amount of soluble compounds, which result in low water activity (Aw) values from 0.7 to 0.9 (Vermeulen, 2014).

2.6 Protein Content

Proteins were nitrogen-containing substances that formed by amino acids. It's functions as a major structural component of muscle and other tissues in the body. Also, It was used to produce hormones, enzymes, and hemoglobin. Proteins could also use as energy; However, they are the unprimary choice as an energy source (Hoffman and Falvo, 2004).

Goats were famous herbivores for their ability to survive with a variety of grass and foliage as a feed. Like other meats, goat meat mainly based on protein and fat. The protein in goat meat balanced with essential and non-essential amino acids. It also contained high levels of taurine, carnitine, and inosine which were important for human health (Nagamine, Sunagawa, and Kina, 2013). Jerky was the most commonly available dried meat product, which sliced, seasoned and dried with rich protein and low lipid contents in various types and shapes (Sun-Lu and Geum-Soon, 2004).

The protein content of dry-cured fermented sausages ranged from 22.3% to 34.5% (Bolumar, Toepfl, and Heinz, 2015). The nutritional content of beef sausage fermented with 1.5% Angkak had a protein content of 16.56%. Minimum standards of the Indonesian National Standard 1995 with a minimum value of 13% (Atma, 2015). The protein content average of *kacang* goat meat was 19.40% (Imam et al., 2103). Proteolytic enzymes grouped by their effects and location. According to the action, the most important proteolytic enzyme was the protease, related to breaking down proteins into peptides and large peptides, which hydrolyzed large peptides into smaller ones and became free amino acids. (Petrova, Inga, Turid, Trygve, 2015).

2.7 Dissolved Protein Content

Levels of dissolved protein increased due to the fermentation process; microbe hydrolyzed complex proteins became free amino acids or simpler peptides in the presence of proteolytic enzyme activity (Onweluzo and Nwabugwu, 2009). The structure and composition of amino acids alter the solubility of a protein in various solvents, a standard method used to classify proteins. Among the different types of proteins, proteins were more soluble in water or saline solution (albumin and globulin), more widely degraded by bacteria than the less soluble protein types (glutamine, glutelin) (Owens and Basalan, 2016).

Dissolved protein was an oligopeptide and easily absorbed by the digestive system. The total protein was the measurement of nitrogen (N) content in the sample (Purwoko and Handajani, 2007). Changes of fish TCA-soluble peptides throughout fermentation increased from 1.01±0.06 to 5.89±0.09. The increasing TCA-soluble peptides content indicated great hydrolysis of muscle proteins during fermentation (Wang et al., 2017). Some protein were hydrophilic (water soluble) like albumin (Tu et al., 2015).

2.8 Protein profile

The protein component of meat could be one of parameters that used to identify the characteristic been of the meat. One of the choice method, which is easy, cheap and prevail to determine the protein in meat was electrophoresis SDS PAGE (Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis). By using this method, we could provide protein profile of the sample according to the molecular weight (MW) (Zilhadia, Betha, and Ummi, 2014). Sodium dodecyl-

sulfate polyacrylamide gel electrophoresis (SDS-PAGE) was commonly used to obtain high resolution separation of complex mixtures of proteins. The method initially denatured the proteins that will undergo electrophoresis (Nowakowski, Wobig, and Petering, 2014).

Electrophoretic techniques can employed for meat species identification because meat products were tissue mixtures made primarily from proteins. On the other hand, protein composition might vary depending not only on species but also on many other factors, including tissue type, storage time of the product and technological processes employed to manufacture it (Montowska and Pospiech, 2011). Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) performed to establish the extent of protein aggregation as well as to assess the use of microwave technology in acceleration of protein digestion (Montowska and Pospiech, 2016).

The protein composition changed along the fermentation. Decreased protein fraction accompanied by an increase in the insoluble fraction. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis showed most of the protein bands to shrink or disappear due to the proteolysis or denaturation. New bands appeared mainly on insoluble proteins (Wang, Xia, Gao, Xu, and Jiang, 2017). The addition of bacteria increased the value of viscosity; it might be due to the effect of proteolytic enzymes from bacteria that could break down polypeptide bonds shorten and the protein denatured until becoming solids (Budiarti, Padaga, and Fatchiyah, 2013). In general, as competitive species, LAB acted to break down proteins in the surrounding media for intracellular nutrient supply (Zhou, Theunissen, Wels, and Siezen, 2010).

CHAPTER III
MATERIALS AND METHODS

3.1 Time and location

The research conducted from November 2017 to January 2018 at Laboratory of Animal Products Technology, Microbiology and Handling of Livestock Product Division of Faculty of Animal Science Brawijaya University Malang to make *dendeng*, fermentation process, and moisture content test. Aw, protein content, and dissolved protein content test conducted at Food Technology and Agricultural Products Laboratory of Gadjah Mada University Yogyakarta. Protein profile test conducted at Epidemiology Laboratory Faculty of Animal Science Brawijaya University Malang.

3.2 Materials

3.2.1 Material of Research

The main ingredients to make fermented goat *dendeng* was the thigh of goat meat species of *kambing kacang (Capra hircus)* aged from 1 – 2 years purchased from Kebalen Traditional Market, Zaenal Zakse street, Malang. Goat meat milled at Tawangmangu Traditional Market, Lowokwaru district, Malang. The other ingredients were palm sugar, garlic, coriander, galangal, cumin, salt, pepper, and added with *Lactobacillus plantarum* FNCC 0027 that propagated with *deMan Rogosa Sharp Agar* (MRS-A), *deMan Rogosa Sharp Broth* (MRS-B), skimmed milk, and sugar. The materials analysis were $BaCl_2.{}_2H_2O$ liquid for Aw. H_2SO_4, NaOH, pp indicator, boric acid solution, and HCl for protein content. Biuretic reagents, ammonium sulfate crystals,

acetic acid buffers pH 5, aquadest, BSA protein solution for dissolved protein content. Phosphate buffer saline, reducing sample buffer, a protein marker for protein profile. The formulation of fermented goat *dendeng* with *Lactobacillus plantarum* shows in Table 2.

Table 2. Ingredients and Composition of Fermented Goat Dendeng

Ingredients	Total			
	T_0	T_1	T_2	T_3
Goat Meat	150 g	150 g	150 g	150 g
Lactobacillus plantarum	0	0.3 ml	3 ml	30 ml
Salt	3 g	3 g	3 g	3 g
Palm sugar	25 g	25 g	25 g	25 g
Garlic	7.5 g	7.5 g	7.5 g	7.5 g
Galangal	1 g	1 g	1 g	1 g
Cumin	0.25 g	0.25 g	0.25 g	0.25 g
Pepper	0.5 g	0.5 g	0.5 g	0.5 g
Coriander	2 g	2 g	2 g	2 g

Source: Veerman et al. (2013) with modification

3.2.2 Equipment

The equipment that used for making fermented goat *dendeng* were *dendeng* mold (thick glass 3 (three) millimeters, plastic gloves food grade, aluminum foil, bread paper, analytical scale with accuracy 0.01 gram, spoon, soxhlet, basin, oven. The equipment for the propagation of *Lactobacillus plantarum* FNCC 0027 were erlenmeyer 200 ml, petri dish, reaction tube with the rack, incubator, autoclave, ose wire, and pipette.

Equipment for analysis was Aw meter for Aw test. Oven, desiccator, analytical balance, and petridish for moisture content. Spectrophotometer, test tube, kjeldahl tube, kjeldahl heater, distillation tool, buret 50 ml, erlenmeyer flask 250 ml, spatula, weighing paper, measuring flask 25 ml, pipette drops, and glass funnel for protein content. Micropipette, 1 ml volumetric pipette, 10 ml volumetric pipette, 500 ml measuring flask, 10 ml reaction tube, stirring bar, funnel, filter paper, spectrophotometer for dissolved protein content. A set of electrophoresis, a set of HPLC devices, centrifugator, micropipette, microtube, tip, analytical balance, mortar, and measuring cup for protein profile.

3.3 Method

The research method was using experimental design with four treatments and four replications. Treatment differences based on the level of *Lactobacillus plantarum* lactic acid as follows:

T_0: *Dendeng* without adding *Lactobacillus plantarum*
T_1: *Dendeng* with 0.3 ml *Lactobacillus plantarum*
T_2: *Dendeng* with 3 ml *Lactobacillus plantarum*
T_3: *Dendeng* with 30 ml *Lactobacillus plantarum*

Table 3. Tabulation Data

Treatment	Replication			
	R_1	R_2	R_3	R_4
T_0	T_0R_1	T_0R_2	T_0R_3	T_0R_4
T_1 (0.3 ml)	T_1R_1	T_1R_2	T_1R_3	T_1R_4
T_2 (3 ml)	T_2R_1	T_2R_2	T_2R_3	T_2R_4
T_3 (30 ml)	T_3R_1	T_3R_2	T_3R_3	T_3R_4

Determination of the treatment using this calculation:

1 ml + 500 g $\longrightarrow 10^8$ CFU/500 g $= 2x10^5$ CFU/g
10 ml + 500 g $\longrightarrow 10x10^8$ CFU/500 g $= 2x10^6$ CFU/g
100 ml + 500 g $\longrightarrow 100x10^8$ CFU/500 g $= 2x10^7$ CFU/g

Where, in 1 ml liquid culture expected 10^8 CFU and using 500 g of *dendeng* dough. *Dendeng* dough that used is only 150 g. Then, generate calculations as below:

150 g x $2x10^5$ CFU/g = $0.3x10^8$ CFU $\longrightarrow$ 0.3 ml
150 g x $2x10^6$ CFU/g = $3x10^8$ CFU $\longrightarrow$ 3 ml
150 g x $2x10^7$ CFU/g = $30x10^8$ CFU $\longrightarrow$ 30 ml

Then, the bacterial solution used is 0, 0.3, 3, and 30 ml. The optical densities of 3 mL of bacterial solutions were determined by using a UV-VIS Spectrophotometer daily at the same time after inoculation. *L. plantarum* was measured at four different wavelengths (490, 520, 545, and 600 nm) (Rahman, Halim, Mahawi, Hasnudin, Al-Obaidi, and Abdullah, 2017). The distance used as much as 10 ml to get a significant difference in the treatment.

3.4 Research Design

3.4.1 Preparation of Sample

Purchased the goat meat and then milled it. Weighed the spices and then smoothed. Mixed the meat with spices, stirred it until evenly distributed. Divided the dough into 4 (four) according to treatment. Inoculated with starter *Lactobacillus plantarum* according to the treatment used consist of 0 ml, 0.3 ml, 3 ml, and 30 ml. The *dendeng* dough wrapped with aluminum foil. Put it into incubator 37℃ for 24 hours. The *dendeng* dough mold using glass with a thickness of 3 (three) millimeters. Dry it using the oven with temperature 40℃ for 9 (nine) hours. Wait until the *dendeng* in normal temperature for 15 minutes before packed and labeled. Figure 2 illustrates this process.

3.4.2 Propagation of *Lactobacillus plantarum*

The process of propagation *Lactobacillus plantarum* inoculated pure culture as much 1 (one) ose wire into *deMan Rogosa Sharp* Agar (MRS-A), then incubated at 37℃ for 48 hours and ready for use as working cultures to make a starter. The remainder stored at -4℃ as culture stock. *deMan Rogosa Sharp Broth* (MRS-B) sterile as much as 5 ml inoculated with working culture as much as 1 (one) ose wire the incubated at 37℃ for 48 hours to obtain a liquid culture. The liquid culture inoculated as much as 1% into a 50 ml skimmed milk which was sterile and incubated at 37℃ for 24 hours to obtain the parent starter. The bulk starter prepared with 1% parent starter inoculated with skimmed milk 50 ml and glucose or sugar 3 grams for 24 hours at a

temperature at 37℃ for 48 hours with SPC (Standard Plate Count) method. The flowchart shows in Figure 3.

3.5 Variables

The variables for this research were a physico-chemical test (moisture content, Aw, protein content, and dissolved protein content) and protein profile test. The procedure analysis of all variables present in Appendix 1 – 6.

3.6 Statistical Analysis

The statistical analysis from this research was using Completely Randomized Design then tabulated with Microsoft Excel and statistical analysis that used ANOVA (Analysis of Variance). If the data obtained a significant difference, it would follow by DMRT (Duncan Multiple Range Test).

The Completely Randomized Design mathematical model is:

$$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$$

Notes: Y_{ij} = observation of the main factors
μ = general average
τ_i = primary effect on level to-i
ε_{ij} = influence of error
I = 1, 2, 3, 4.....a
J = 1, 2, 3, 4.....u

3.7 Terminology

Goat Meat	:	Meat has a paler color that sheep meat (mutton) and has white color on the fat part.
Intermediate Moisture Food	:	A food product that has a moisture content between 10 – 50%, Aw (activity water) between 0.6 – 0.9, and elastic texture that allows forming, and longer shelf life compared to other foods.
Dendeng	:	Slashed or ground meat, seasoned with spices, and dried with sunlight or low heat.
Lactobacillus plantarum	:	Homofermentative bacteria that can be able to break down a complex compound into the simple compound with the result is lactic acid.

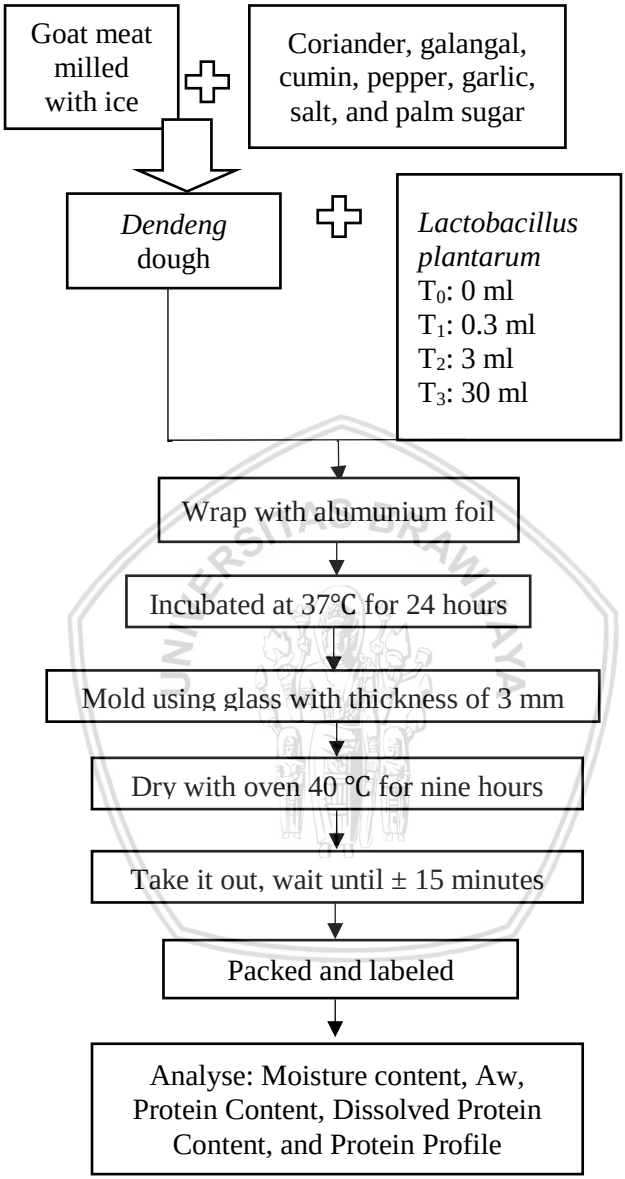

Figure 2. Flowchart of Fermented Goat *Dendeng* de Macedo, Pflanzer, and Gomez (2012) with modification

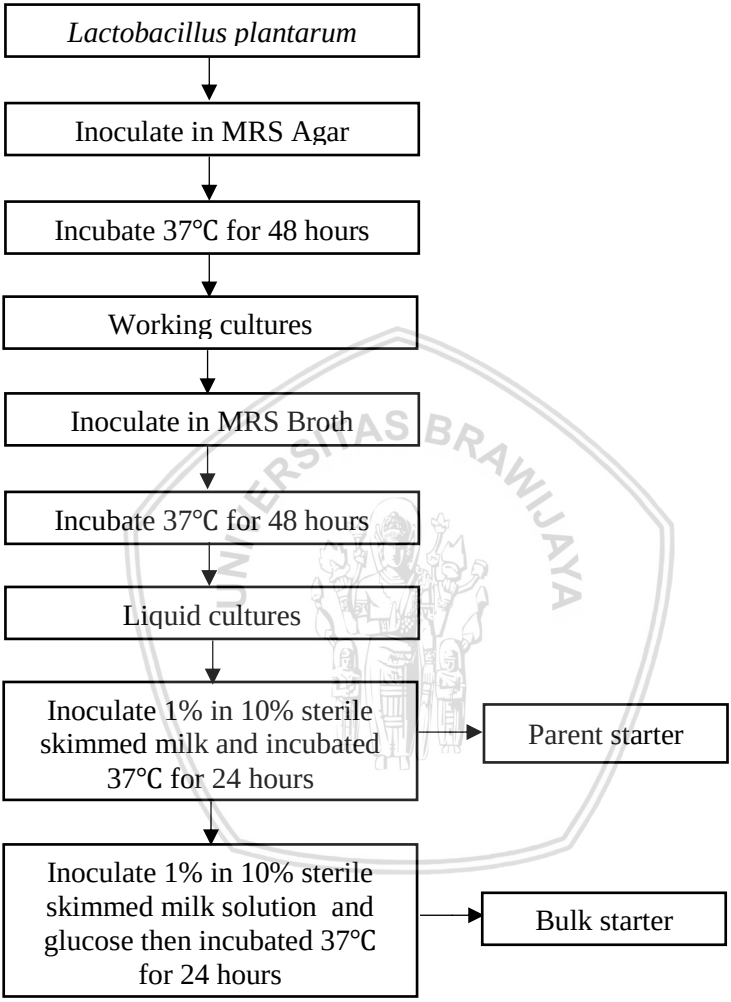

Figure 3. Propagation of Lactobacillus Plantarum (Setioningsih, Setyaningsih, and Susilowati, 2004)

CHAPTER IV
RESULTS AND DISCUSSIONS

Fermented goat *dendeng* had a brown color, crunchy texture, spicy also specific flavor, and without goat odor. Huang and Nip (2001) stated that *dendeng* had a sweet taste because its sugar content and strong taste of spices and dried meat provided a distinctive flavor that sets it apart from other traditional moisturizing products. *Dendeng* had a long shelf life due to decrease the moisture content. *Dendeng* was one of the durable meat products that classified as preservation meat. Preservation was a process by using of nitrate salt (saltpeter) to maintain the color of meat, distinctive taste and control the growth of microorganisms (Suradi, 2014).

Fermented goat *dendeng* was good quality food; goat meat was one source of protein and the fermentation process affect the quality of *dendeng*. Considering their high nutritional value and a greater ratio of unsaturated fatty acids, goat meat had the potential to improve the health of people who rarely consumed meat products from their daily diet. Goat meat consumption was becoming popular and often available (Malekian et al., 2014). The process of fermentation by the appropriate way and the level was able to produce protein products, decrease fat content, and formed (simplified) complex carbohydrates (Suhendra et al., 2010). Fermented goat *dendeng* present in Figure 4.

Figure 4. Fermented Goat *Dendeng*

This research used goat meat then processed become *dendeng* by addition of *Lactobacillus plantarum*. The lactic acid bacteria added to the product with different levels. All treatments analyzed for moisture content, Aw, protein content, dissolved protein content, and protein profile. The product tested in intermediate moisture food condition after drying process. The results of the analysis present in Table 4.

Table 4. The Average Value of Moisture Content (%), Aw, Protein Content (%), Dissolved Protein Content (%), and Protein Profile Fermented Goat Dendeng

Treatment	Moisture content (%)	Aw	Protein Content (%)	Dissolved Protein Content (%)
T_0	44.24 ± 0.75^a	0.61 ± 0.01^a	31.98 ± 0.64^a	3.55 ± 0.13^a
T_1	44.93 ± 0.72^a	0.67 ± 0.02^b	35.28 ± 0.81^b	3.95 ± 0.03^b
T_2	46.48 ± 0.44^b	0.68 ± 0.02^b	38.34 ± 0.40^c	4.14 ± 0.02^b
T_3	46.65 ± 0.55^b	0.70 ± 0.00^b	38.70 ± 0.88^c	4.21 ± 0.17^c

Notes: The different superscripts in the same column show highly significant effect ($P<0.01$)

4.1 Moisture content of Fermented Goat *Dendeng*

The results of the data and the analysis of the moisture content variance (Appendix 7) showed that the addition of *Lactobacillus plantarum* in the fermented goat *dendeng* had an effect. Duncan test result showed that T_0 unsignificant different with T_1 and T_2 unsignificant different with T_3. Moisture content affected to the shelf life and the activity of water (aw) on *dendeng*. The final moisture content had a significant impact on texture and shelf life, with a lower moisture content lead to confections that typically had a longer shelf life (Ergun et al., 2010). The relation of moisture content with water activity (aw) indicated by the tendency that the high the moisture content then, would obtain high aw value. Moisture content expressed in percent (%) in the range of 0-100 scale, while the value of aw expressed in decimal places in the range of 0-1.0 scale (Legowo and Nurmanto, 2004).

The average value of moisture content shows in Table 4. Based on Table 4, the results showed that more level of *Lactobacillus plantarum* added would increase the moisture content. The highest moisture content obtained from the T_3 treatment was 46.65% and the lowest moisture content obtained from the T_0 treatment was 44.24%. While the moisture content of T_1 treatment was 44.93% and T_2 treatment was 46.48%. The moisture content of *dendeng* was still in accordance with the previous research. Mean moisture content values (%) for dry fermented lamb-meat sausage during processing and storage was ranged from 32.84% to 57.32% (Bowser et al., 2014). *Dendeng* belong to semi-wet food products, according to Huang and Nip (2001) semi-wet food products had a moisture content of 15% -50%.

Dendeng that made was an intermediate moisture food because it had a high moisture content than *dendeng* in general. Indonesian national standard recommends the value of moisture content for beef *dendeng* maximum 12% (SNI, 2013). The moisture content was still high due to maintaining lactic acid bacteria to keep growing. Intermediate moisture foods (IMF) contain between 20 and 50% (w/w) of water (Vermeulen, 2014). Water was vital for many biological processes and essential for all living organisms (Lebre et al., 2017).

The moisture content increased because during the fermentation of lactic acid bacteria *Lactobacillus plantarum* occurred a hydrolysis process (Figure 6) that produced H_2O. All types of living organisms were able to produce a variety of ribosomally synthesized antibacterial peptides or proteins (Hou et al., 2017). The formation of one peptide bond results in the removal of one water molecule (Nes and Holo, 2000). The fermentation sausage was most likely the formation of texture dominated by acid-induced muscle protein gelation and the amount of water released (Chen et al., 2016). Water molecule removal in enzymatic process increased the moisture content of *dendeng*.

4.2 Aw (Water Activity) of Fermented Goat *Dendeng*

The results of the data and the analysis of the Aw variance (Appendix 6) showed that the addition of *Lactobacillus plantarum* in the fermented goat *dendeng* had an effect. Duncan test result showed that T_1 unsignificant different with T_2 and T_3. The value of Aw on *dendeng* product affected the growth of microorganisms such as bacteria. Water activity (aw) was a major factor in preventing or limiting growth (bacteria causing foodborne diseases will not grow under aw of 0.85), but further,

it could also lead to increased resistance of microorganisms and spores (Sevenich et al., 2015)

The average value of Aw shows in Table 4. Based on Table 4, the results showed that more level of *Lactobacillus plantarum* added would increase the Aw value. The highest Aw value obtained from the T_3 treatment was 0.7 and the lowest Aw value obtained from the T_0 treatment was 0.61. While Aw value of T_1 treatment was 0.67 and T_2 treatment was 0.68.

Higher Aw values in *dendeng* with the addition of *Lactobacillus plantarum* (T_1, T_2, T_3) were due to the effect of microorganism activity compared with T_0 treatment without the addition of *Lactobacillus plantarum*. Water activity (aw) was the amount of water that microorganisms could use for their growth (Setyanigsih et al., 2014). Moisture content increased in *dendeng* also affected the increasing of Aw value. Legowo and Nurmanto (2004) stated that the relation of moisture content with water activity (Aw) indicated by the tendency that the high moisture content then, would obtain high Aw value. Moisture content expressed in percent (%) in the range of 0-100 scale, while the value of aw expressed in decimal places in the range of 0-1.0 scale.

The value of aw *dendeng* was still in accordance with the standard. Afrila and Jaya (2012) stated that the value of Aw *meat* ranged from 0.44 to 0.49. Indonesian national standard recommends the value of water activity (Aw) for meat in around 0.4-0.9. If, the sample (*dendeng*) had a water activity (Aw) was not too high or not too low, i.e., between the ranged 0.50-0.90 then the sample (*dendeng*) could be durable during storage. Intermediate Moisture Foods (IMF), high amount of soluble compounds, which resulted in low water activity (Aw) values of (aw) from 0.7 to 0.9 (Vermeulen, 2014).

4.3 Protein Content of Fermented Goat *Dendeng*

The results of the data and the analysis of the protein content variance (Appendix 8) showed that the addition of *Lactobacillus plantarum* in the fermented goat *dendeng* had an effect. Duncan test result showed that T_2 unsignificant different with T_3, while T_2 and T_3 have significant different with T_0 and T_1. The protein had an important role in the metabolism of the human body. So, the protein was an important substance for human consumption. Hoffman and Falvo (2004) stated Proteins were nitrogen-containing substances that formed by amino acids. It's functions as a major structural component of muscle and other tissues in the body. Also, It was used to produce hormones, enzymes, and hemoglobin. Proteins could also use as energy; However, they were the unprimary choice as an energy source.

The average value of protein content shows in Table 4. Based on Table 4, the results showed that more level of *Lactobacillus plantarum* added would increase the protein content. The highest protein content obtained from the T_3 treatment was 38.70% and the lowest protein content obtained from the T_0 treatment was 31.98%. While the protein content of T_1 treatment was 35.28% and T_2 treatment was 38.34%. The protein content of *dendeng* was still in accordance even had a high value with the previous research and standard. Atma (2015) stated that the nutritional content of beef sausage fermented with 1.5% Angkak had a protein content was 16.56% from minimum standards of the Indonesian National Standard 1995 with a minimum value was 13%. Indonesian national standard recommends the value of protein content for beef *dendeng* minimum 18% (SNI, 2013).

Dendeng fermented with *Lactobacillus plantarum* had a higher protein content compared to *dendeng* in general due to the fermentation process that breaks the protein structure (Figure 6). Proteolytic enzymes grouped by their effects and location. According to the action, the most important proteolytic enzyme was the protease, related with breaking down proteins into peptides and large peptides, which hydrolyzed large peptides into smaller ones and became free amino acids (Petrova, Inga, Turid, Trygve, 2015). The protein content of dry-cured fermented sausages ranged from 22.3% to 34.5% (Bolumar et al., 2015). The protein content average of *kacang* goat meat was 19.40% (Imam et al., 2103).

4.4 Dissolved Protein Content of Fermented Goat *Dendeng*

The results of the data and the analysis of the dissolved protein content variance (Appendix 8) showed that the addition of *Lactobacillus plantarum* in the fermented goat *dendeng* had an effect. Duncan test result showed that T_1 unsignificant different with T_2, while T_1 and T_2 have significant different with T_0 and T_3. Dissolved protein was an oligopeptide and easily absorbed by the digestive system. The total protein was the measurement of nitrogen (N) content in the sample (Purwoko and Handajani, 2007).

The average value of dissolved protein content shows in Table 4. Based on Table 4, the results showed that more level of *Lactobacillus plantarum* added would increase the dissolved protein content. The highest dissolved protein content obtained from the T_3 treatment was 4.21% and the lowest dissolved protein content obtained from the T_0 treatment was 3.55%.

While the dissolved protein content of T_1 treatment was 3.95% and T_2 treatment was 4.14%.

Dissolved protein content increased from T_0 treatment was 3.55% to T_3 treatment was 4.21%. The fermentation process used *Lactobacillus plantarum* showed an effect on the dissolved protein content of *dendeng*. Levels of dissolved protein increased due to the fermentation process; microbe hydrolyzed complex proteins became free amino acids or simpler peptides in the presence of proteolytic enzyme activity (Onweluzo and Nwabugwu, 2009)

The increasing of dissolved protein content because of hydrolysis of protein during the fermentation and increasing of moisture content. Changes of fish TCA-soluble peptides throughout fermentation increased from 1.01±0.06 to 5.89±0.09. The increasing TCA-soluble peptides content indicated great hydrolysis of muscle proteins during fermentation (Wang et al., 2017). Some protein were hydrophilic (water soluble) like albumin (Tu et al., 2015).

4.5 Protein Profile of Fermented Goat *Dendeng*

Electrophoresis analysis conducted in this research using 12% separating gel and 3% stacking gel. The molecular weight can be seen only protein with molecular weight 16.69-143.54 kDa. Electrophoresis analysis showed T_1 treatment had molecular weight was 143.54, 126.94, 93.34, 77.62, 41.97, 27.29 kDa. T_2 treatment had molecular weight was 143.54, 64.55, 50.47, 41.97, 34.90, 30.86, 16.69 kDa. T_3 treatment had molecular weight was 143.54, 64.55, 50.47, 41.97, 30.86, 27.29, 18.87, 16.69 kDa. Whereas, the molecular weight of T_0 treatment was unread. Electrophoresis analysis results see in figure 5.

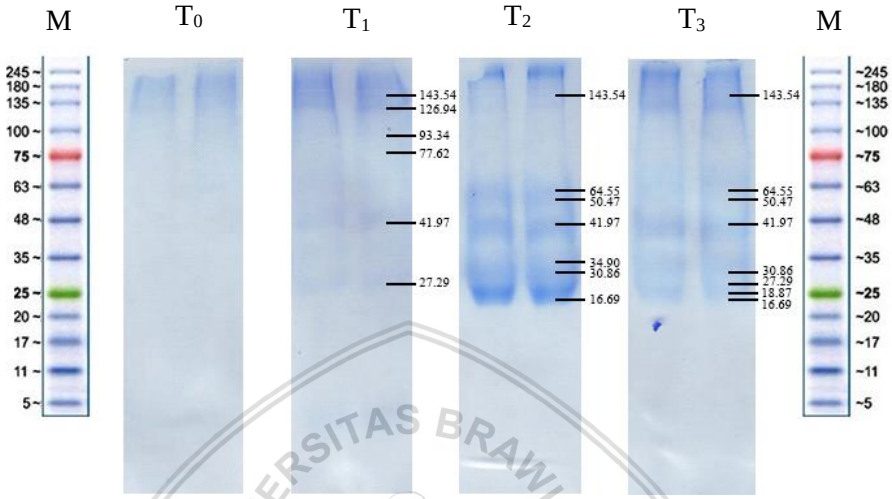

Figure 5. Electrophoresis Results of Fermented Goat Dendeng

The differences between T_0, T_1, T_2, and T_3 treatment in protein profile analysis was T_0 had unreadable protein band, T_1 had six protein bands, T_2 had seven protein bands, and T_3 had eight protein bands. The molecular weight of TrkB (*Tropomyosin receptor kinase B*) was 143.54 kDa (Banerjee, Hazra, Ghosh, and Mondal, 2014). 126.94 was *quinoline-C5,8,10, Quinoline* exhibited good anti-mycobacterial activities and were the promising compounds in discovering new anti-Tuberculosis agents (Joshi, More, Dixit, Dubey, Tripathi, Kulkarni, 2014). The 93 kDa protein *gephyrin* is a tubulin-binding peripheral membrane protein (Langosch, Hoch, and Betz, 1992). *Lactoferrin*, a cationic 78 kDa protein (Jiang, 2013). *Terpene synthase* (theoretical molecular mass: 64.55 kDa) (Roeder, Hartmann, Effmert, and Piechulla, 2007). Theoretical weight was 50.47 kDa with gene name was IGHG1 (*Immunoglobulin*) (Saphire, Parren, Pantophlet, Zwick, Morris,

Rudd, Dwek, Stanfield, Burton, and Wilson, 2001). Myofibrillar proteins corresponding to *actin* (42 kDa); LC1, slow-twitch light chain *myosin* (27.5 kDa); and LC3, fast-twitch light chain *myosin* (16 kDa), and almost all sarcoplasmic proteins were lower than normal (Mudalal, Babini, Cavani, and Petracci, 2014). *Translocator protein* (18 kDa) proposed as a new name, regardless of the subcellular localization of the protein, the 30-kDa *adenine* nucleotide translocase (Papadopoulos, Baraldi, Guilarte, Knudsen, Lacapere, Lindemann, Norenberg, Nutt, Weizman, Zhang, and Gavish, 2006). A protein with a molecular weight of 35.2 kDa was a *hemaaglutinin* protein (Mufida and Suswati, 2007).

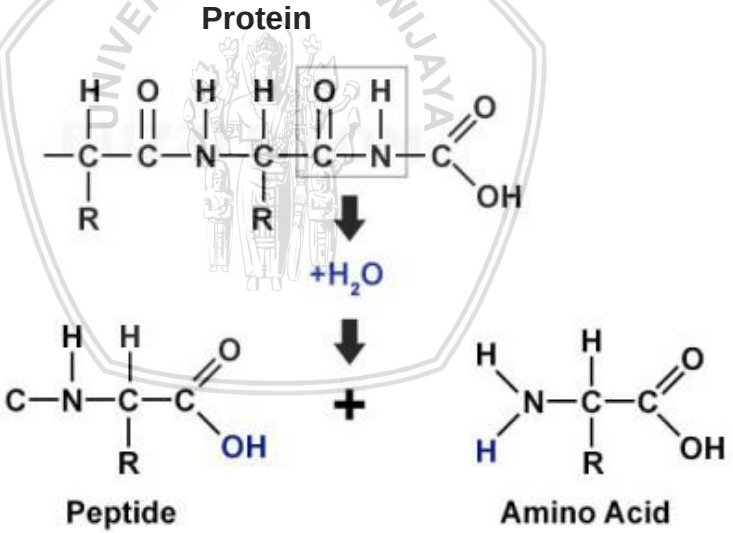

Figure 6. The Hydrolysis of Peptide Bond Scheme

The molecular weight of the protein changed due to the fermentation process that occurs in *dendeng*. The hydrolysis process that breakdown protein become small peptides shows in Figure 6. Wang, Xia, Gao, Xu, and Jiang (2017) stated that the protein composition changed along the fermentation. Decreased protein fraction accompanied by an increase in the insoluble fraction. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis showed most of the protein bands to shrink or disappear due to the proteolysis or denaturation. New bands appeared mainly on insoluble proteins. The addition of bacteria increased the value of viscosity; it might be due to the effect of proteolytic enzymes from bacteria that could break down polypeptide bonds shorten and the protein denatured until becoming solids (Budiarti et al., 2013). In general, as competitive species, LAB acted to break down proteins in the surrounding media for intracellular nutrient supply (Zhou, Theunissen, Wels, and Siezen, 2010).

The molecular weight on T_0 unread probably due to the size of protein molecule still large then difficult to enter the gel. As the sample moved through the column, smaller molecules passed through the pores in the beads talking a longer path through the column than larger molecules that difficult to enter the beads and simply travel around them. Proteins separated based upon their size large and small molecule (Semester, 2004).

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Addition of *Lactobacillus plantarum* to fermented goat *dendeng* will affect moisture content, Aw, protein content, dissolved protein content and protein profile. Moisture content will decrease due to the heating process, *dendeng* with the addition of *Lactobacillus plantarum* have higher moisture content than *dendeng* without addition of *Lactobacillus plantarum*. Aw value increase because of its high moisture content. Protein content increase due to the hydrolysis process during fermentation. Dissolved protein content increase because of its high protein content and relate with high moisture content, some protein soluble in water. Electrophoresis bands form at most in *dendeng* with addition of 30 ml *Lactobacillus plantarum* while in *dendeng* without addition of *Lactobacillus plantarum* of the band is unreadable. Based on molecular weight found, equivalent with protein such as *Tropomyosin receptor kinase B, Quinoline, Gephyrin, Lactoferrin, Terpene synthase, Immunoglobulin, Actin, Myosin, Translocator protein, Adenine, Hemagglutinin.* Processing of goat meat become fermented goat *dendeng* have nutritional value (moisture content, Aw, protein) which is still feasible for human consumption.

5.2 Recommendations

Based on the results of research that obtain, need to do further research to show the shelf life of the product. Also, further research will need a test to determine the name of protein types and amino acid contained in fermented goat *dendeng.* Further research with the addition of different lactic acid bacteria will need to perform a comparison.

REFERENCES

Afrila, A. dan B. Santoso. 2011. Water Holding Capacity (WHC), Kadar Protein, dan Kadar Air Dendeng Sapi pada Berbagai Konsentrasi Ekstrak Jahe (Zingiber officinale Roscoe) dan Lama Perendaman yang Berbeda. *Jurnal Ilmu dan Teknologi Hasil Ternak*, 6(2): 41-46

Afrila, A. dan F. Jaya. 2012. Keempukan, pH dan Aktivitas Air (Aw) Dendeng Sapi pada Berbagai Konsentrasi Ekstrak Jahe (Zingiber officinale Roscoe) dan Lama Perendaman yang Berbeda. *Jurnal Ilmu dan Teknologi Hasil Ternak,* 7(2): 6-12

Anggraini, A. and Yunianta. 2015. Effect of Papain Hydrolysis Temperature and Time on Chemical, Physical and Organoleptic Characteristic of Edamame Milk. *Jurnal Pangan dan Agroindustri*, 3(3): 1015-1025

Arena, M. P., D. Fiocco, S. Massa, V. Capozzi, P. Russo. 2014. *Lactobacillus plantarum* as a strategy for an *in situ* production of vitamin B2. *J. Food. Nutr. Disord*., 1: 4

Arena, M. P., A. Silvain, G. Normanno, F. Grieco, D. Drider, G. Spano, and D. Fiocco. 2016. Use of *Lactobacillus plantarum* Strains as a Bio-Control Strategy against Food-Borne Pathogenic Microorganisms. Front Microbiol., 7: 464

Asheim, L. J., L. O. Eik, and I. Dellal. 2014. Production Systems for the Muslim Goat's Meat Market. *Tanzania Journal of Agricultural Sciences*, 12(2): 26-34

Atma, Y. 2015. Studi Penggunaan Angkak Sebagai Pewarna Alami dalam Pengolahan Sosis Daging Sapi. *Jurnal Teknologi*, 7(2): 76-85

Badan Standar Nasional Indonesia. SNI 2908:2013: Dendeng Sapi

Badan Standar Nasional Indonesia. SNI 01-2891-1992: Cara Uji Makanan dan Minuman

Banerjee, R., S. Hazra, A. K. Ghosh, and A. C. Mondal. 2014. Chronic Administration of Bacopa Monniera Increases BDNF Protein and mRNA Expressions: A Study in Chronic Unpredictable Stress Induced Animal Model of Depression. *Korean Neupsychiatric Association*, 11(3): 297-306

Bolumar, T., S. Toepfl, V. Heinz. 2015. Fat Reduction and Replacement in Dry-Cured Fermented Sausage by Using High Pressure Processing Meat as Fat Replacer and Olive Oil. Pol. *J. Food Nutr. Sci*., 65(3): 175–182

Bowser, T. J., M. Mwavita., A. A. Sakini, W. McGlynn, and N. O. Maness. 2014. Quality and Shelf Life of Fermented Lamb Meat Sausage with Rosemary Extract. *The Open Food Science Journal*, 8: 22-31

Budiarti, I. K., M. C. Padaga, and Fatchiyah. 2013. Nutritional Composition and Protein Profile of Goat Yogurt PE with Double Culture between Streptococcus Thermophilus and Lactobacilus Species. *Cukurova Medical Journal*, 38(4): 681-686

Chen, X., J. Li, T. Zhou, J. Li, J. Yang, W. Chen, and Y. L. Xiong. 2016. Two Efficient Nitrite-reducing *Lactobacillus* Strains Isolated from Traditional Fermented Pork (Nanx Wudl) as Competitive Starter Cultures for Chinese Fermented Dry Sausage. *Meat Science*, 121: 302-309

De Macedo, R. E. F., Pflanzer, S. B., and C. L. Gomes. 2012. Lab Probiotic in Animals: Probiotic Meat Products Chapter 5. Intech.

Dhanda, J.S., D. G. Taylor, P. J. Murray, R. B. Pegg, and P. J. Shand. 2003. Goat Meat Production: Present Status and Future Possibilities. *Asian-Aust. J. Anim. Sci*., 16(12): 1842-1852

Erickson, L. E. 1982. Recent Developments in Intermediate Moisture Foods. *Journal of Food Production*. 45(5): 484-491

Hargono, Abdullah, dan I. Sumantri. 2008. Pembuatan Kitosan dari Limbah Cangkang Udang serta Aplikasinya dalam Mereduksi Kolesterol Lemak Kambing. *Reaktor*, 12(1): 53-57

Hoffman, J. and M. J. Falvo. 2004. International Society of Sports Nutrition Symposium. *Journal of Sports Science and Medicine*, 3(3): 118-130

Hou, Y., Z. Wu, Z. Dai, G. Wang, G. Wu. 2017. Protein Hydrolysates in Animal Nutrition: Industrial Production, Bioactive Peptides, and Functional Significance. *J. Anim. Sci. Biotechnol*., 8: 24

Huang, T. C. and W. K. Nip. 2001. Intermediate-moisture Meat and Dehydrated Meat. *Meat Science and Application*, 42: 403

Ivanovic, S., I. Pavlovic, and B. Pisinov. 2016. The Quality of Goat Meat and It's Impact on Human Health. *Biotechnology in Animal Science*, 32(2): 111-122

Jiang, Q-Q. 2013. Discovery of Potent Inhibitors of Human B-Tryptase by Protein Surface Recognition. *Chem. Sci.*

Joshi, S. D., U. A. More, S. R. Dixit, D. Dubey, A. Tripathi, V. H. Kulkarni. 2014. Discovering Potent Inhibitors Against The Enoyl-Acyl Carrier Protein Reductase (InhA) of Mycobacterium tuberculosis: Structure-Based Design, Synthesis and Antimicrobial Activity of Quinoline Hydrazone. *Indo American Journal of PAhrmaceutical Research*, 4(2): 864-877

Langosch, D., W. Hoch, and H. Betz. 1992. The 93 kDa Protein Gephyrin and Tubulin Associated with The Inhibitory Glycine Receptor are Phosphorylated by An Endogeneous Protein Kinase. *European Biochemical Societies*, 298: 2-3

Lebre, P. H., Pieter D. M., and Don A. C. 2017. Xerotolerant Bacteria: Surviving Through a Dry Spell. *Nature Review Microbiology*, 15: 285-296

Legowo, A. M. dan Nurwanto. 2004. Analisis Pangan. Diktat Kuliah. Program Studi Teknologi Ternak. Fakultas Peternakan, UNDIP. Semarang. 54 hlm.

Legowo, R., R. Lietha, and R. W. Hartel. 2010. Moisture and Shelf Life in Sugar Confections. *Critical Review Food Science and Nutrition*, 50:162–192

Li, J., Z. Tu, L. Zhang, X. Sha, H. Wang, J. Pang, P. Tang. 2016. The Effect of Ginger and Garlic Addition during Cooking on The Volatile Profile of Grass Carp (*Ctenopharyngodon idella*) Soup. *J. Food Sci. Techno*., 53(8): 3253-3270

Malekian, F., M. Khachaturyan, S. Gebrelul, and J. F. Henson. 2014. Composition and Fatty Acid Profile of Goat Meat Sausages with Added Rice Bran. *International Journal of Food Science*, 1-8

Montowska, M. and E. Pospiech. 2011. Authenticity Determination of Meat and Meat Products on the Protein and DNA Basis. *Food Review International*, 27: 84-100

Montowska, M. and E. Pospiech. 2016. Processed Meat Protein and Heat-Stable Peptide Marker Identification Using Microwave-Assisted Tryptic Digestion. *Food Technol. Biotechnol*, 54(4): 482-488

Mudalal, S., E. Babini, C. Cavani, and M. Petracci. 2014. Quantity and Functionality of Protein Fractions in Chicken Breast Fillets Affected by White Striping. *Poultry Science*, 2108-2116

Mufida, D. C. and E. Suswati. 2007. Protein Hemaglutinin 35.2 kDa Pili *Proteus mirabilis* P355 sebagai Adhesin pada Epitel Vesika Urinaria Kelinci. *Jurnal Ilmu Dasar,* 8(1): 68-74

Nagamine, I., Sunagawa K., and Kina T. 2013. Use of Awamori-pressed Lees and Tofu Lees as Feed Ingredients for Growing Male Goats. *Asian Australas J Anim Sci*. 26: 1262–1275

Nes, I. F. and H. Holo. 2000. Class II Antimicrobial Peptides from Lactic Acid Bacteria. *Peptide Sciences*, 55: 50-61

Nowakowski, A. B., W. J. Wobig, and D. H. Petering. 2014. Native SDS-PAGE: High Resolution Electrophoretic Separation of Protein with Retention of Native Properties Including Bound Metal Ions. *Metallomics*, 6(5): 1068-1078

Nummer, B. A., Judy A. H., Mark A. H., Patricia K., John N. S., and Elizabeth L. A. 2004. Effects of Preparation Methods on the Microbiological Safety of Home-Dried Meat Jerky. *Journal of Food Production*, 67(10): 2337-2341

Onweluzo, J. C. and Nwabugwu C. C. 2009. Fermentation of Millet and Pigeon Seeds for Flour Production: Effects on Composition and Selected Functional Properties. *Pakistan Journal of Nutrition*, 8: 737-744

Ozawa, T., J. Nishitani, S. Odake, N. Lopez, and H. Blair. 2005. Goat Meat Acceptance in Japan: Current Situation and Future Prospect. *Animal Science Journal*, 76: 305-312

Papadopoulos, V., M. Baraldi, T. R. Guilarte, T. B. Knudsen, J. Lacapere, P. Lindemann, M. D. Norenberg, D. Nutt, A. Weizman, M. Zhang, and M. Gavish. 2006. Translocator Protein (18 kDa): New Nomenclature for The Peripheral-Type Benzodiazepine Receptor Based on Its Structure and Molecular Function. Pharmacological Science, 27(8): 402-409

Petrova, I., Inga M. A., Turid R., Trygve M. E. 2015. Manufacturing of Dry-Cured Ham: A Review. Part 1. Biochemical Changes during The Technological Process. Eur Food Res Technol., Review Paper: Cross Mark

Princy, Y. 2016. Kebijakan Indonesia dalam Menolak Impor Sapi Brazil Tahun 2009-2014. *JOM FISIP*, 3(1): 1-17

Purwoko, T. and N. S. Handajani. 2007. Kandungan Protein Kecap Manis Tanpa Fermentasi Moromi Hasil Fermentasi *Rhizopus oryzae* dan *R. oligosporus. Biodiversitas*, 8(2): 223-227

Roeder, S., A-M. Hartmann, U. Effmert, and B. Piechulla. Regulation of Simultaneous Synthesis of Floral Scent Terpenoids by The 1,8-Cineole Synthase of *Nicotiana suaveolens. Plant Mol. Biol.*, 65: 107-124

Rahman, N. A., M. R. A. Halim, N. Mahawi, H. Hasnudin, J. R. Al-Obaidi, and N. Abdullah. 2017. Determination of The Use of *Lactobacillus plantarum* and *Propionibacterium freudenreichii* Aplication on Fermentation Profile and Chemical Composition of Corn Silage. *Biomed Res Int.,* 2038062

Saenab, A., E. B. Laconi., Y. Retnani, dan M. S. Masud. 2010. Evaluasi Kualitas Pelet Ransum Komplit yang Mengandung Produk Samping Udang. *JITV*, 15(1): 31-39

Sanger, G. 2010. Oksidasi Lemak Ikan Tongkol (Auxis thazard) Asap yang direndam dalam Larutan Ekstrak Daun Sirih. *Pacific Journal*, 2(5): 870-873

Saphire, E. O., Parren P. W., Pantophlet R., Zwick M. B., Morris G. M., Rudd P. M., Dwek R. A., Stanfield R. L., Burton D. R., Wilson I. A. 2001. Crystal Structure of The Intact Human IGG B12 with Broad and Potent Activity Against Primary HIV-1 Isolates: A Template for HIV Vaccine Design. *Science*, 293: 1155-1159

Saputro, E., V. P. Bintoro, and Y. B. Pramono. 2016. Color, Pigment and Residual Nitrite of Dendeng Sapi Naturally Cured at Various Levelof Celery Leaves and Incubation Temperatures. *Journal of the Indonesian Tropical Animal Agriculture*, 41(2): 99-105

Selhub, E. M., A. C. Logan, A. C. Bested. 2014. Fermented Foods, Microbiota, and Mental Health: Ancient Practice Meets Nutritional Psychiatry. *J. Physiol Anthropol*, 33(1): 2

Semester, S. 2004. Determining The Molecular Weight of Amylase by Gel Filtration/Size Exclusion Chromatography. *BS/LBS159H*

Setioningsih, E., R. Setyaningsih, dan A. Susilowati. 2004. Pembuatan Minuman Probiotik dari Susu Kedelai dengan Inokulum *Lactobacillus casei, Lactobacillus plantarum, dan Lactobacillus acidophilus*. *Bioteknologi*. 1 (1): 1 – 6

Setyanigsih, I., W Trilaksani, Desniar, E. Masruroh., R. Fahlevy, V. T. Gentini. 2014. Kajian Kerusakan Tablet Hisap Spirulina Selama Penyimpanan. *Jurnal Ilmu Pertanian Indonesia*, 19(3): 179-182

Sevenich, R., K. Reineke, P. Hecht, A. Frohling, C. Rauh, O. Schluter, and D. Knorr. 2015. Impact of Different Water Activities (Aw) Adjusted by Solutes on High Pressure High Temperature Inactivation of *Bacillus amyloliquefaciens* Spores. *Frontlers in Microbiology*. 6(689): 1-11

Singh, A., N. Yadav, and S. Sharma. 2012. Effect of fermentation on physicochemical properties and invitro starch and protein digestibilities of selected cereals. *International Journal of Agricultural and Food Science*, 2(3): 66-70

Suhendra, N., R. Samsudin., I. Melati. 2010. Peningkatan Kualitas Bahan Nabati (Dedak Padi dan Dedak Polar) melalui Proses Fermentasi (*Rhyzopus oligosporus*) dan Penggunaannya dalam Pakan Ikan Mas (*Cyprinus carpio*). *Prosiding Forum Inovasi Teknologi Akuakultur*: 689-695

Sun-Lu, L. and P. Geum-Soon. 2004. The Quality Characteristics of Beef Jerky Prepared with Various Spices. *Korean J. Food Cookery Sci*, 20:489–497

Sunagawa, K., T. Kishi, A. Nagai, Y. Matsumura, I. Nagamine, and S. Uechi. 2013. Goat Meat Does Not Cause Increased Blood Pressure. *Asian-Australas J. Anim. Sci*., 27(1): 101-114

Suradi, K. 2014. Potensi dan Peluang Teknologi Pengolahan Produk Kelinci. *JITV*: 1623

Suryati, T., M. Astawan, H. N. Lioe, and T. Wresdiyati. 2012. Curing Ingredients, Characteristics, Total Phenolic, and Antioxidant Activity of Commercial Indonesian Dried Meat Product (Dendeng). *Media Peternakan*, 66: 111-116

Tamang, J. P., D. Shin, S. Jung, S. Chae. 2016. Functional Properties of Microorganisms in Fermented Foods. *Front Microbiol*, 7: 578

Tiwari, B. K. and N. Singh. 2012. Pulse Chemistry and Technology. Manchester: RSC Publishing

Troy D.J. and Kerry J.P. 2010. Consumer Perception and The Role of Science in The Meat Industry. *Meat Science*, 86: 214−226

Veerman, M., Setiyono, dan Rusman. 2013. Pengaruh Metode Pengeringan dan Konsentrasi Bumbu Serta Lama Perendaman dalam Larutan Bumbu terhadap Kualitas Fisik dan Sensori Dendeng Babi. *Bulletin Peternakan*. 37(1) 34 – 40

Vermeulen, A., C. L. Marvig, J. Daelman, R. Xhaferi, D. S. Nielsen, F. Devlieghere. 2014. Strategies to Increase The Stability of Intermediate Moisture Foods towards *Zygosaccharomyces rouxii:* The Effect of Temperature, Ethanol, pH, and Water activity with or without The Influence of Organic Acid. *Food Microbiology*, 1-7

Wang, W., W. Xia, P. Gao, Y. Xu, and Q. Jiang. 2017. Proteolysis during Fermentation of Suanyu as a Traditional Fermented Fish Product of China. *International Journal of Food Properties*, 28(51): 5166-5176

Yilmaz, I. and Murat V. 2009. Fermented Meat Products. *Transworld Research Network*, 37(2): 1-151

Yuliani, E., Lukman H.Y., Lanus S., and Yufika D.M. 2013. Sinyal Kebuntingan Dini Pada Sapi Bali. Bogor: Seminar Nasional dan Forum Komunikasi Industri Peternakan

Zhou, M., D. Theunissen, M. Wels, and R. J. Siezen. 2010. LAB-Secretome: A Genome-Scale Comparative Analysis of The Predicted Extracellular and Surface-Associated Proteins of Lactic Acid Bacteria. *BMC Genomics*, 11: 651

Zilhadia, O. S. Betha, C. Ummi. 2014. Protein Profiles of Beef (*Bos indicus*). Pork (*Sus domesticus*), and Sausage by Using SDS-PAGE (Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis) Method. *J. Food Pharm. Sci.*, 2: 46-51